Transportation Master Plan
For The Greater Texas Medical Center Area

Technical Memorandum 4

ALTERNATIVE MOBILITY IMPROVEMENT STRATEGIES

Prepared for

The City of Houston

Prepared by

- **AECOM Consulting Transportation Group**
- **Kimley-Horn Associates, Inc.**
- **LKC Consulting Services**
- **Texas Transportation Institute**
- **Walter P. Moore & Associates, Inc.**

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Introduction

Technical Memorandum 3 described the goals, objectives, and guiding principles to provide a basis for developing mobility improvement strategies for the Greater Texas Medical Center Area. This technical memorandum describes the improvement options that were developed and considered as part of the transportation master plan process.

From the beginning, it was apparent that the study area has areas of high levels of activity, such as the Texas Medical Center, Rice University, and Reliant Park that generate high levels of transportation demand. At the same time, residential neighborhoods adjacent to major institutions and other non-residential areas seek to maintain a residential character consistent with a lower level of transportation activity. Hermann Park, one of the City of Houston's major parks, has its own character as one of the city's unique recreational and open space assets. The area has other sections that have different character, such as the Museum District, Rice Village, retail strips, and warehouse/distribution areas, each generating a different type of transportation need. Together, they present a challenge to blend a variety of land uses and neighborhood character while providing the level of mobility needed to make them functional and successful.

Hence, developing transportation improvement strategies for this area is a challenge to blend a number of factors together to come as close as possible to achieving the desired blend of mobility and area character so all parts of the area receive as much benefit as possible. At the same time, the diversity resulting from free market development in the study area makes it necessary to find the middle ground between conflicting needs and objectives for adjacent areas within the study area. For example, location of high intensity activity areas and residential neighborhoods adjacent to each other places areas with high mobility needs next to areas with low mobility needs. Although not often considered when purchasing a home or locating a business, the very nature of this inconsistency necessitates compromise and special compensating efforts to help both areas each obtain most of what they need and want.

The strategies developed for the study area resulted from examination of both consistent and conflicting needs. The strategies considered not only improvements to the transportation system to provide more capacity and continuity, but also actions that could reduce travel demand and therefore the need for more capacity. Clearly it is impossible to meet all objectives and desires expressed by the area's stakeholders. Any improvement will necessitate finding the middle ground that provides each affected sub-area as much benefit as possible.

Process For Developing Alternative Strategies

The process used to develop alternative mobility improvement strategies consisted of the following steps:

- Meet with stakeholders to identify their future plans and needs, suggestions for improving mobility and related conditions in the area, as well as issues and concerns affecting their interests.
- Assess mobility needs for the area over the planning period extending to at least 2025.

- Review goals, objectives, and guiding principles agreed to by the stakeholder committees (Technical and Steering Committees).
- Propose possible multi-modal concepts consisting of policies, travel demand reduction actions, and system improvements.
- Review initial ideas with stakeholder committees and obtain suggestions for improving the alternative improvement strategies.
- Revise alternative strategies to reflect consensus of input.

Evaluation of the alternative strategies and selection of a preferred long-term strategy is discussed in Technical Memorandum 5. This technical memorandum discusses the development of three alternative long-range strategies for the Greater Texas Medical Center Area.

Transportation-Related Needs

The goals, objectives, and guiding principles agreed to by the stakeholder committees and documented in Technical Memorandum 3 provide one set of needs. They point to the approach to be used in developing possible long-range strategies as well as the desired character of the area and the resulting transportation system. An estimate of mobility needs point to the location and magnitude of the transportation system projected by 2025.

On entering this study, one of the underlying directives stated by METRO was that the light rail line currently under construction through the area, the future TMC transit center, and the park-and-ride facility on Fannin south of IH-610, represent the full extent of major transit capital improvements within the study area through 2025. Minor capital improvements may be considered during that time, but available resources for capital improvements will be used elsewhere to provide system improvements around METRO's service area. However, service improvements are considered regularly by METRO and can be considered as part of this study. Hence, no major transit capital improvements were considered in developing strategies extending through 2025.

Travel Demand

The Houston-Galveston Area Council (HGAC) forecasts travel demand throughout the Greater Houston urbanized area. The latest forecast available at the time the study began was used to estimate demand for vehicular travel. Daily estimates were available covering a typical weekday 24-hour period. Estimates reflect transit travel covering about 5.4 percent of daily person trips including pedestrian and bicycle demand.

Bicycle and pedestrian daily trips are often considered an extension to the transit system and therefore bus and rail activity is dependent on pedestrian mobility and bicycle mobility. These figures are averages and are not applicable to each corridor or sub-area within the study area.

Figure 1 shows the estimated 2025 traffic volumes on the baseline major street system of the study area. This system is what is included on the HGAC Metropolitan Transportation Plan plus the major thoroughfare plan of the City of Houston and committed (funded and programmed)

improvements. In general, traffic volumes would increase by between 2 and 80 percent. (At the same time, the percentage of trips made other than driving is projected to increase from the present 4.7 percent to about 5.4 percent by 2025.

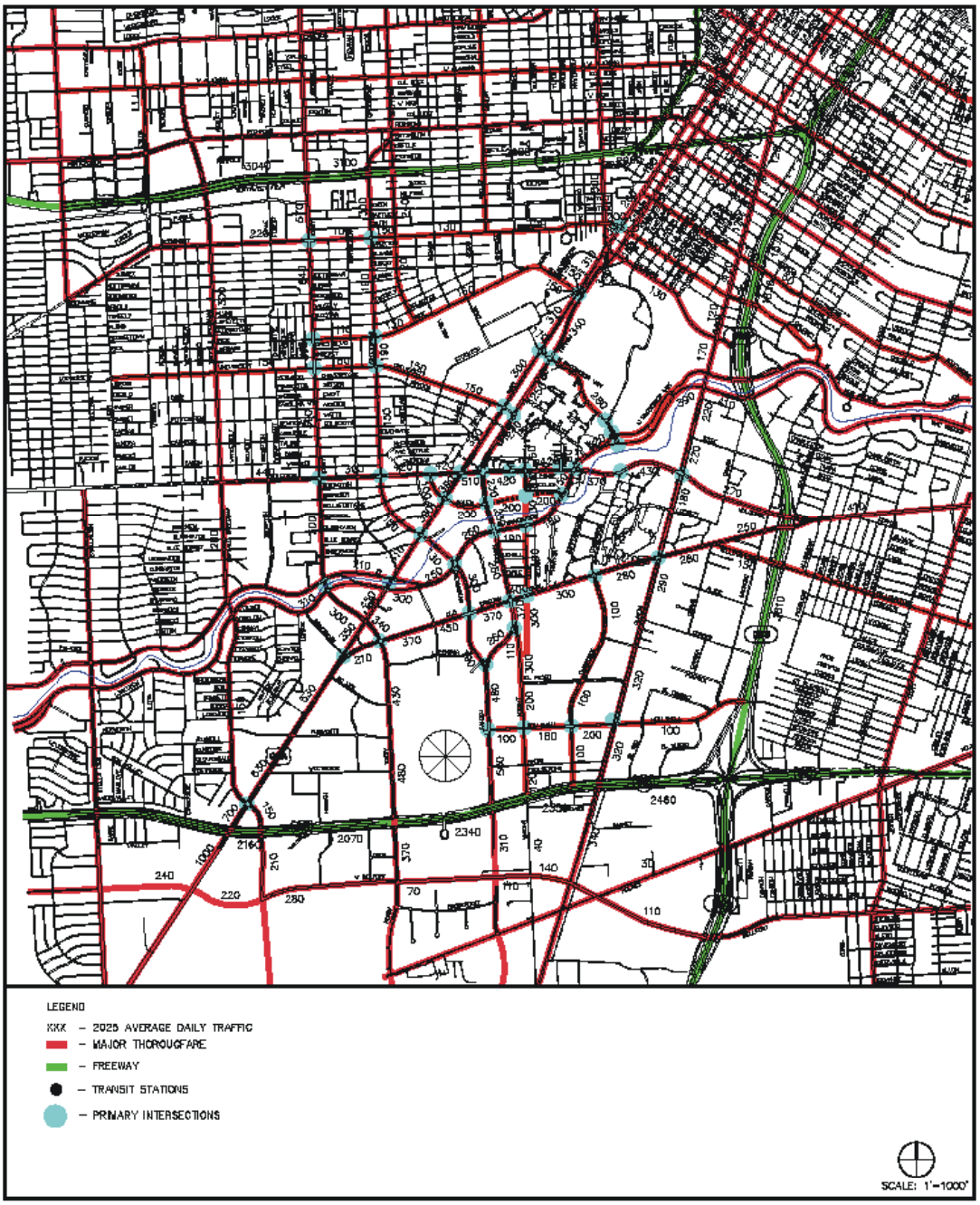


FIGURE 1: 2025 Baseline Major Road System Daily Traffic Volumes

An assessment of demand and a comparison with planned capacity (including committed road improvements and METRO light rail transit [LRT] and service improvements) was completed. Using corridors rather than individual street (assumes optimum use of available capacity within

each sector of the study area), it was determined that an additional four to six north-south lanes (desirably from TMC west) and four more east-west lanes (desirably north of Reliant Park) will be needed by 2025. This assessment was based on HGAC road capacity estimates and assumed that an "overflow" on one major street would result in traffic using the next adjacent parallel major street if capacity is available.

Figure 2 highlights some of the other transportation system needs in the study area. This Figure does not include policy needs to reduce travel demand or operational needs to increase the effectiveness of the available transportation resources. The following section summarizes all three types of needs beyond the capacity needs described above.

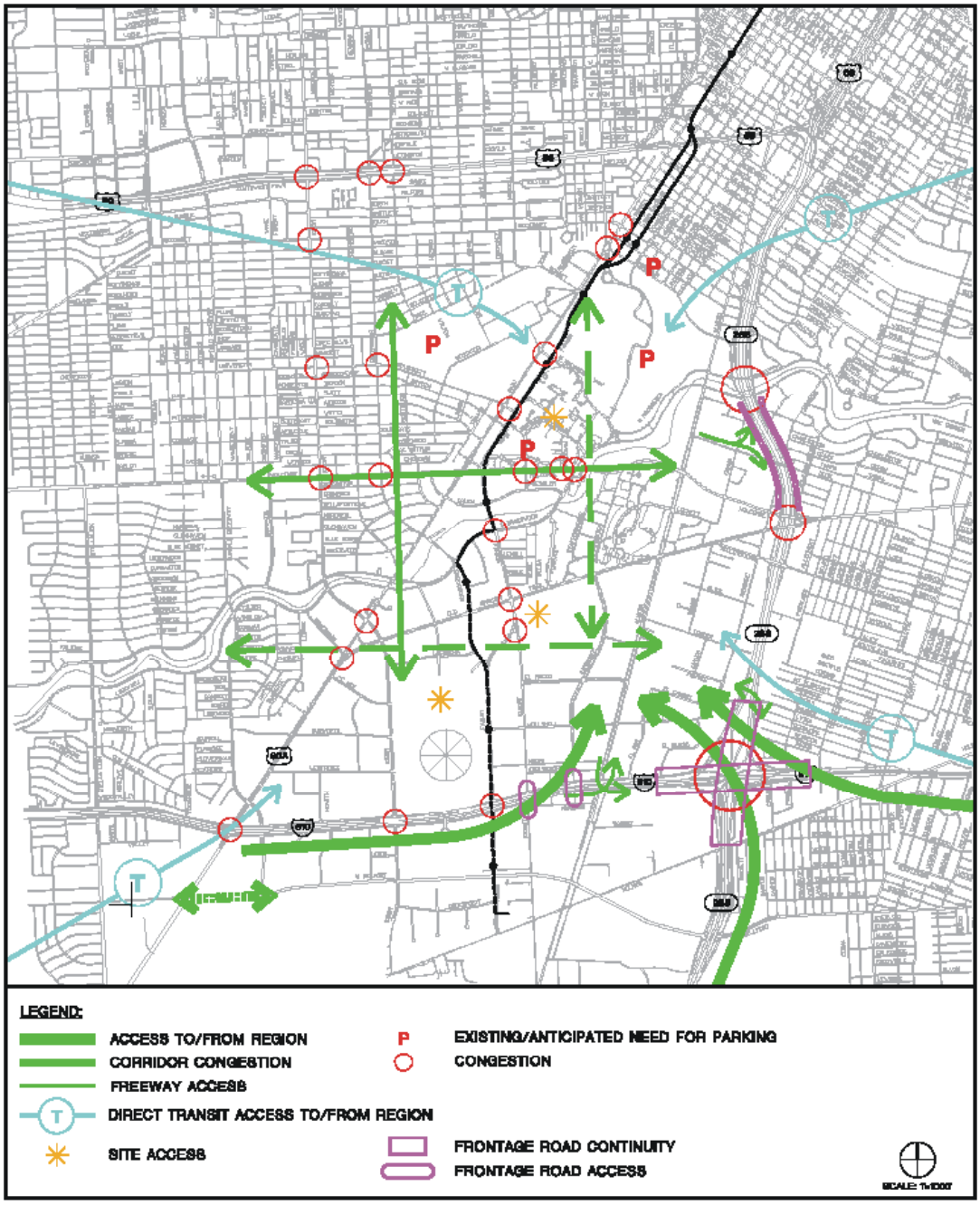


FIGURE 2: Transportation System Needs

Transportation System Continuity

Street system continuity was also reviewed. Rice University, Hermann Park, TMC, and Reliant Park all present barriers to travel across the area in both north-south and east west directions. Providing continuous routes to accommodate medium length trips to and through the study area

is one of the challenges in the study area. The level of development that exists in the study area would normally have continuous major streets averaging one-half mile apart. In the north-south direction, Kirby, Greenbriar, Main, Fannin-Knight, and Almeda provide arterial continuity on average spacing of less than one-half mile. However, Knight's and Almeda's lack of full access to IH-610 makes them less than fully effective as an area arterial street since traffic must use other streets to use the freeway to and from the east.

In the east-west direction, only Bissonnet-Binz, Holcombe, and Braeswood-MacGregor provide east-west continuity between US 59 and IH-610, a distance of nearly four miles, an average spacing of about 1.3 miles.

Hence, on the basis of both travel demand and continuity, additional continuous major streets should be provided over the next 20 years if possible.

Freeway Access

Freeway service to the study area is via three freeways – IH-610, US 59, and SH 288 – that bound the study area on three sides. Due to the design of the freeways and interchanges between them, area access is limited near the IH-610/SH 288 and US 59/SH 288 interchanges. While frontage roads offer some connections between these proximities and available ramps, access is still limited in the following areas:

- to/from the east on IH-610 between Knight and Almeda,
- to/from the south on SH 288 using Holly Hall, and
- US 59 between Main-Fannin and Shepherd-Greenbriar.

Existing or potential major streets such as Knight, Cambridge, Almeda, Holly Hall, and Montrose have partial or no freeway access, thus forcing area traffic to other streets to gain freeway access. This has led to some major street congestion while other parallel streets are much less used. Frontage road continuity and/or additional or relocated ramps could improve access to and from areas adjacent to these sections.

Bicycle and Pedestrian Facilities Strategies

In a dynamic and diverse area like the TMC, bicycle and pedestrian mobility are essential. From pedestrian access to and from parking facilities to safe access to transit stops, pedestrian and bicycle mobility must be maintained and improved. As part of this study, bicycle and pedestrian facilities within this TMC and surrounding study area were examined. There are several opportunities for improvement to both systems.

Bicycle Strategy

The bicycle master plan for the TMC and surrounding area is a combination of the City of Houston Bicycle Master Plan and projects necessary to complete the bicycle network for the study area. A bicycle route expansion strategy was established by providing connectivity between parks, schools, major institutions, or residential areas using low volume streets where possible and corridors that appear to provide easy implementation of bicycle facilities. Based on

that strategy, several new bicycle routes have been proposed (exact locations are shown in Figure 3). Additional distinction can be made between types of bicycle facilities (on-road bike lanes and off-road multi-use trails). Most of the proposed bicycle facilities in the TMC are on-road bike lanes, except the Brays Bayou County Bike trail.

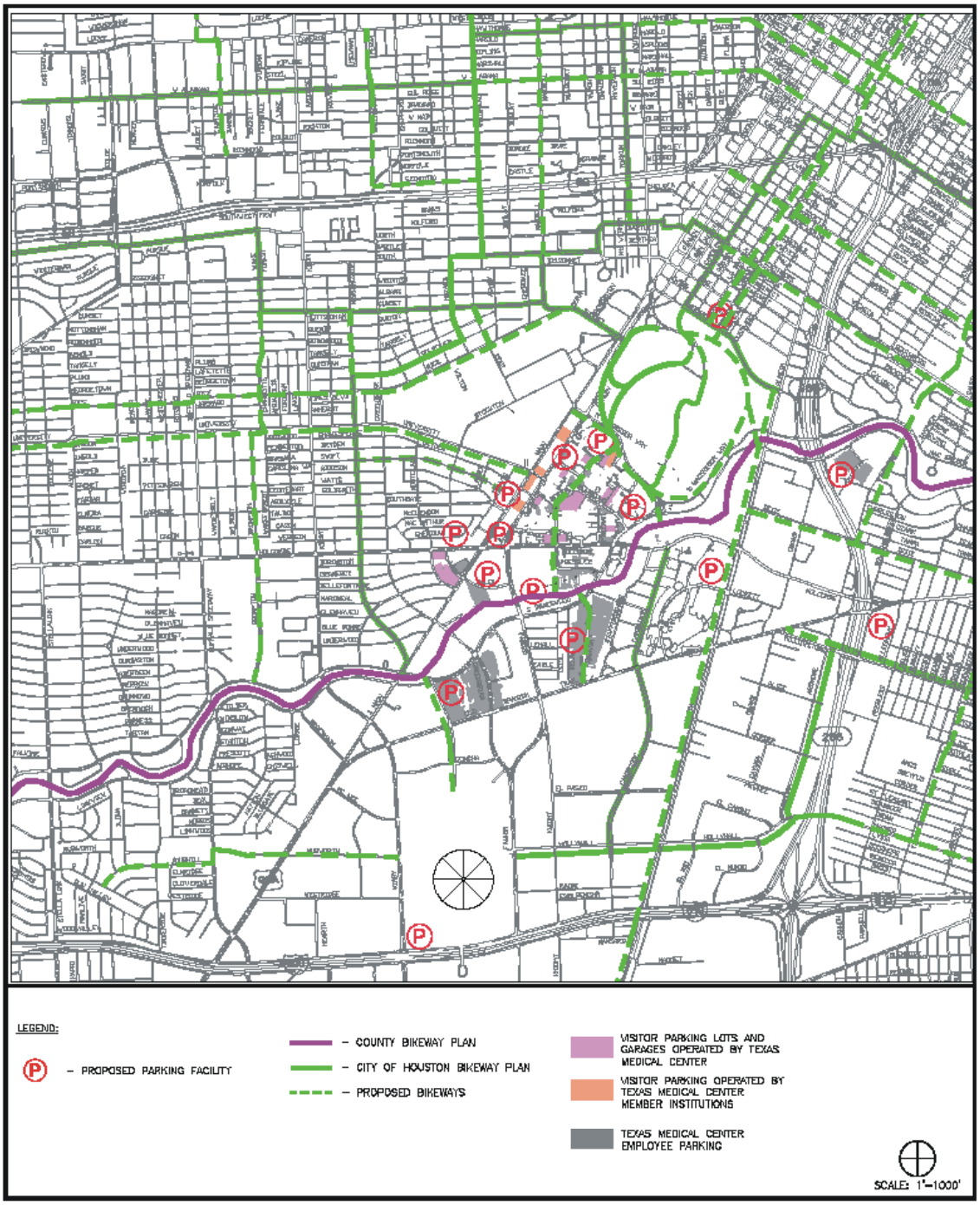


FIGURE 3: Existing and Proposed Bicycle Route Locations

Each bicycle facility will be evaluated and ranked as part of Task 5. Once complete, a plan to initiate bicycle-facility coordination with the City of Houston, the Texas Department of Transportation (TxDOT), and the Texas Parks of Wildlife (TP&W) needs to be developed. Early coordination with those agencies is essential to ensure financing of these capital facilities. Also, if an objective evaluation and ranking is conducted, as noted above, securing capital costs will be streamlined.

Pedestrian Strategy

The pedestrian facilities within the TMC and surrounding study area are primarily comprised of sidewalks and skyways. Sidewalks and pedestrian crossings exist almost everywhere throughout the study area. There are however opportunities for improvements to the pedestrian network to make it more attractive and increase use. Amenities such as benches, trees for shade and where possible, planting strips between sidewalks and curbs would all improve the walking environment. Even more important is the need for convenient connections between buildings and street sidewalks. In many places pedestrians must walk across large expanses of parking lots to reach the street. This does not encourage walking and encourages short driving trips that are unnecessary.

Pedestrian crossings need to be made more convenient at several major intersections in the area, most notably Holcombe-Braeswood and intersections at SH 288. Conflicts with traffic turning movements are extensive and pedestrian crossing time is short.

The following strategy outlines needed intersection improvements, mobility issues at SH 288, and initiating transit and skyway linkages. As a general rule, all existing and future roadways within the TMC area where pedestrian traffic is expected should provide a walking area separated from vehicle travel lanes to ensure safety and provide for increased mobility. The most significant and potentially the most hazardous areas for pedestrians are crossings at intersections. Several intersections have been identified as needing immediate improvement:

- crossings along Holcombe;
- crossings along Fannin (specifically at the future light rail stations);
- Mecom Fountain located near Hermann Park;
- Greenbriar at Rice University; and
- Main at MacGregor.

The intersections above need to be examined in greater detail to pinpoint the proper improvement needed to improve safety for the pedestrian. Many different options to improve safety are available, such as special pedestrian signal phasing, refuge islands, striping, signing, etc. In addition to the intersections above, pedestrian improvements, similar to the ones noted above, at other intersections throughout the TMC should occur as intersection capital improvements are made. Funds should be set aside for pedestrian improvements at intersections.

In addition to intersections, TMC stakeholders have identified the Southmore, MacGregor, and Holcombe bridges over SH 288 as locations needing modifications to make them more pedestrian friendly. At these locations, safe crossings should be provided at both ends of the bridge. To ensure safety, a barrier between the sidewalk and travel lanes may be necessary to

compensate for the lack of available setback, as well as to avoid the high cost of additional bridge width.

Finally, the Texas Medical Center's 50-Year Master Plan includes a skywalk network. Pedestrian traffic will increase as a result of the new rail stations. Where appropriate, there is need for vertical linkages to the skywalk network from the public transit and private shuttle stops. There is also a need to create connections between the planned skywalks and the proposed light rail stations. The four METRO rail stations within the TMC campus will need proper and safe pedestrian access. Coordination between the TMC and METRO needs to address pedestrian access to and from the new transit stations. This coordination has already begun, with several provisions planned to enhance pedestrian safety. These include specific traffic signal phasing, pedestrian crossing locations, and railings or barriers to discourage jaywalking at unprotected locations.

Parking System Strategies

Not including the Rice University area, there are approximately 48,000 existing off-street parking spaces in the study area, which includes the TMC main campus, Hermann Park, Reliant Park, and the Museum District. Also, with the planned expansion of over 7,000,000 square feet of floor space over the next 10 to 15 years, the TMC area alone must provide for an additional 12,600 parking spaces (at a rate of 1.8 spaces per 1,000 square feet). Building on the planning efforts recently completed in the TMC Master Plan, a parking strategy to accommodate future development has been developed. To accommodate the new demand and to help alleviate traffic circulation congestion within the TMC and surrounding study area, a parking strategy needs to be a combination of:

- conversion of existing surface lots to multi-level parking garages,
- build new parking garages,
- provide incentives for peripheral and remote parking,
- initiate a parking and access control system and wayfinding system, and
- create an agency within the TMC to address shared parking issues.

A more detailed description of each strategy is described below:

Convert existing surface lots to multi-level parking garages – A simple solution to locating potential parking structures is to convert existing surface lots to multi-level parking garages. The number of likely locations is limited as most of the land within the core of the TMC (bounded by Fannin, MacGregor Way, Braeswood, and Holcombe) is currently developed; therefore converting existing surface lots may serve as a viable solution when attempting to locate possible garages for additional parking capacity. Some potential lots for conversion are shown in Figure 4.

Build new parking structures – There are a few locations along the major approach routes where new parking structures are a possibility (i.e., along Main, Holcombe and Fannin). As the TMC continues to grow, construction of new parking structures may serve as a more long-term solution. Currently there are proposals for parking garages at the southwest corner of Dryden and Main as well as discussion for a possible garage at Fannin and Galen (see Figure 4).

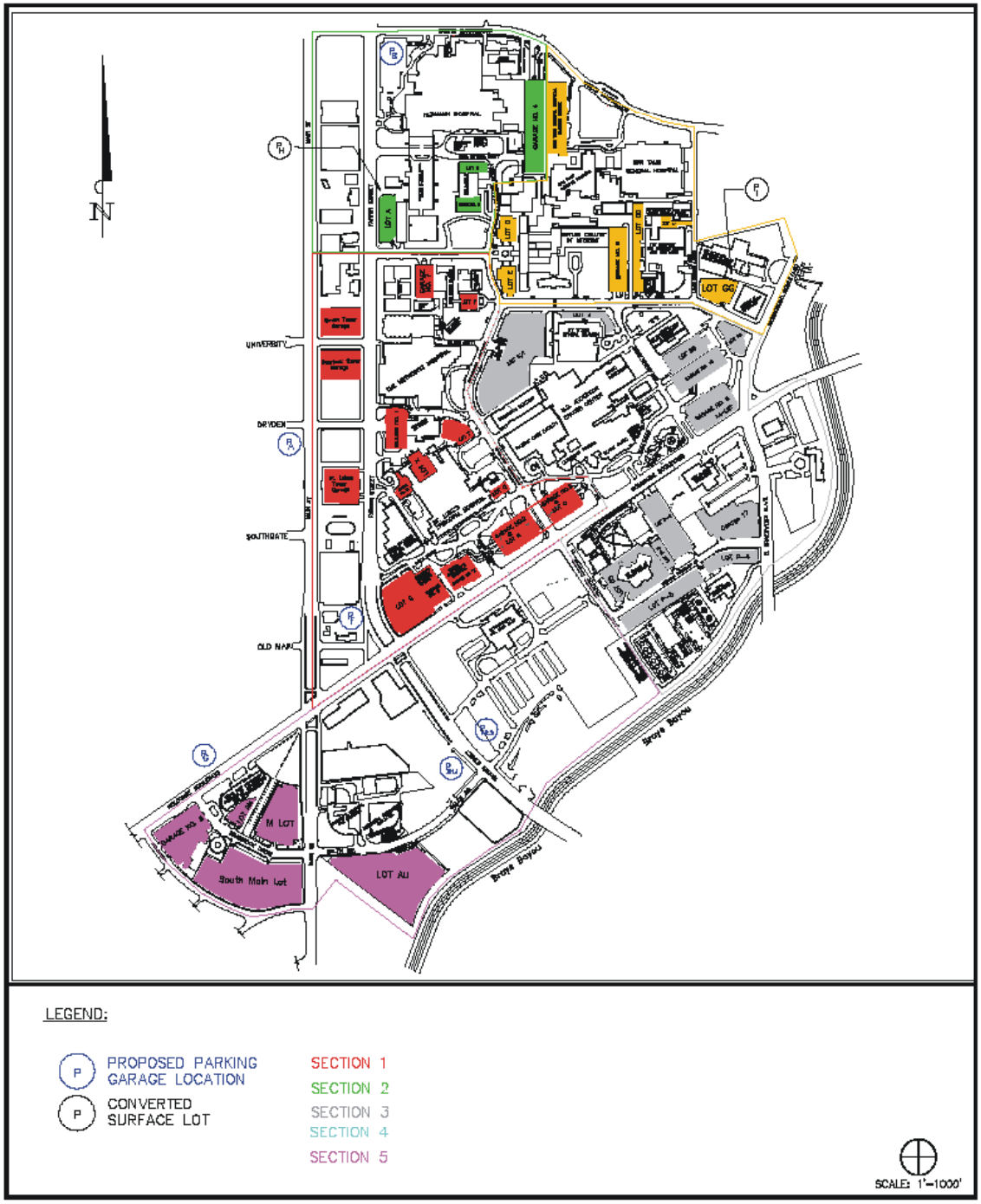


FIGURE 4: Potential Locations For Parking Facilities

Peripheral and Remote Parking – Expansion of the peripheral parking lots and remote lots is also a strategy when addressing additional parking capacity. There is ample opportunity to locate additional surface lots and/or parking garages south of Brays Bayou. With such an option, incentives to encourage use of the lots are generally financial (cheaper parking) and convenience

(avoid activity center traffic). An analysis of exactly what incentives it will take to make patrons utilize the peripheral parking system should be conducted to ensure their utilization.

- *Location of Peripheral Parking Lot* – To maximize the usage of peripheral parking lots, the lots should be located on approach routes to the activity center, no farther than a 15-minute (and preferably shorter) transit or shuttle ride to the final destination. The current Texas Medical Center circulator routes operate at an average speed of 7.2 mph, implying that the parking lots should be located no further than about two miles (along roadways) from the core destinations.

- *Frequency of Service* – Also critical to the success of peripheral and remote parking lots is the frequency of the shuttles serving the lots. Patrons cannot realistically time their arrival at the lot to meet a transit schedule; therefore, the shuttle needs to arrive frequently enough so that the wait time for random arrivals is acceptable. The current Texas Medical Center circulator routes (which also serve parking) operate at an average headway of five minutes during the peak periods. Transit routes serving peripheral parking routes should operate no less frequently than about every seven minutes, implying that the average patron would wait three to four minutes for a bus. Transit service to peripheral lots can also be supplemented with a stop on a regular transit route. While a regular transit route is not likely to have sufficient frequency or excess capacity to accommodate peak-hour demand at a peripheral lot, locating a lot on a regular transit route will allow for cost-effective transit service to the lot during off-peak periods.

- *Capacity of Lots* – The minimum capacity of a lot is related to the desired frequency of service. If the lot is too small, the number of patrons would not be large enough to justify the desired frequency of transit service. For example, assume that a 750-employee space lot fills to about 90% capacity (675 cars) during the morning peak period (6:00 a.m. to 9:00 a.m). If half of those cars arrived in the peak hour, buses departing every five minutes would carry on 28 passengers on average—acceptable average loads.

  Based on the following assumptions:

  - lots fill to at least 90% of capacity during the three hour peak period,
  - half of the cars arrive in the peak hour (or a 25%/50%/25% peak period distribution),
  - bus frequency of no worse than every 7 minutes during the peak hour, and
  - average peak hour transit loads of no less than 25 passengers,

  the minimum lot size would be 500 spaces if no dedicated mid-day service were needed (i.e., regular transit service can provide mid-day access to the lot). While one transit route could serve more than one (presumably smaller) parking lot, the additional travel time for patrons boarding at the first lot would require that the lots lie even closer to the activity center.

  Note that 500 spaces is a bare minimum for an employee lot with no dedicated mid-day service. Assuming that a lot is well located, a larger lot would increase the probability of success by increasing the frequency and span of the shuttle service.

Parking and Access Control – To better utilize the parking facilities within the TMC, implementation of a parking access control and space-counting systems should be considered. Such a system will assure that those patrons who require a parking space are provided that space. An access control system can set an access card's rights for a specific day or days of the week, specific hours of the day or other parameters set by a building owner. An access card can be established for multiple facilities if all facilities are using the same card access system. Once a vehicle enters a parking facility, an accurate occupancy count is needed so that if a facility is full, no additional vehicles are allowed in. An access control system coupled with a parking space count system can limit the number of patrons using a parking facility, easily keeping counts of the access cardholders in the parking facility. Space counting becomes more complex when the vehicle serves a mix of access cardholders and visitors. Access cardholders should always have a parking space available. Therefore, separate counts of access cardholders and visitor activity within a parking facility is necessary. Counts can be taken from the gate arm movement, card reads and tickets issued, or from the detection devices.

Wayfinding - Frequently, a parking guidance signage system is implemented along with a parking space count system. Based on the occupancy counts from the parking space count system, a series of external guidance signs can direct patrons to those parking facilities that have available parking spaces. Parking guidance signs can also be useful inside a parking facility to direct patrons to those areas have available parking space. A parking guidance signage system is especially useful to infrequent parking users because they are in an unfamiliar area and in the case of a hospital or airport environment, are frequently traumatized. External signage can communicate via wireless interconnects and be solar powered, thereby eliminating the need for underground conduit.

Create an agency to address parking within the study area – With all the various institutions within the area it may be advantageous to create an agency to manage and operate the parking system within the TMC area. This agency could coordinate between the various stakeholders within the TMC as well as surrounding (Museum District, Rice University, Hermann Park) to ensure that the area's users benefit from the available parking as much as possible, perhaps utilizing at certain periods some sort of shared parking, where applicable.

Transit Service

The transit system, as currently planned by METRO after initiation of LRT service in early 2004 was also reviewed. Stakeholders suggested that more direct service between the study area and areas to the east is needed to provide convenient access to jobs (many at TMC) and services. Improved transit service between TMC and Rice Village and Almeda between US 59 and Binz was also suggested. Even with LRT service to parts of the area, direct express service to/from park-and-ride lots serving large numbers of area employees was identified as a need to maintain convenient, one bus service.

Vehicular Travel Reduction

Finally, to reduce vehicular travel demand to the levels projected by HGAC, it will be necessary to increase programs aimed at attracting travelers to other modes of travel or off-peak travel times. METRO offers reduced fare transit pass programs to employers and educational institutions, a program that could be widely used in the greater TMC area. At the present time some TMC institutions subsidize transit fares through a transit pass program. For example, Texas Childrens Hospital provides free transit passes to its employees who ride transit to and from work. At the same time, most employers in the area offer free parking or parking that is below actual cost. To affect a mode change, transit must become more attractive financially than driving. In the past few years the federal government has allowed employers to provide tax-exempt payments of $65 per month (increasing over time to $105) to employees for using commute modes other than driving. The METRO transit pass program combined with the federal commute alternatives tax exempt employer incentives could be an attractive way to encourage transit use. Charging full cost for parking would further motivate such a change.

Use of remote parking could reduce vehicular traffic volumes in the core areas of the study area. Provision of parking facilities of over 1,000 spaces each along approach route but at the periphery of the area would bring those who drive to the area but not cause them to drive in the congested core. Frequent shuttle service and preferential pricing would be needed to make remote parking attractive. TMC and member institutions in the Smithlands and South Extension parking areas already provide this type of service.

Another way to reduce traffic volumes is to make walking more attractive for short trips. In many portions of the area, sidewalks and street crossings are either non-existent, do not feel convenient, or require long waits at intersections with long traffic signal cycle lengths. High volume pedestrian corridors could be made more attractive with grade-separated systems similar to those being constructed in some portions of the TMC. Pedestrian priority needs to be provided at signalized pedestrian crossings along potential high volume routes where grade separations are not feasible. All pedestrian routes need attractive sidewalks or paths with appealing amenities such as landscaping, direct routing, separation from (higher volume) traffic streams where possible. Similarly, bicycle travel for short trips should also be made more convenient and comfortable. A network of bike routes providing direct connections between major destinations is critical. These routes should be, to the extent possible, located on lower-volume streets or separate paths, be provided with sufficient widths, and use signalized intersections to cross high volume streets.

Other actions and programs that can contribute to the reduction of total or peak period travel and are applicable in this area. Some of these include:

Institutional Programs

- Subsidized employer and school transit pass programs.
- Coordinated scheduling of work, class, and event start and finish times to spread and offset travel demand across longer periods.
- Priority and/or lower cost parking for carpools and vanpools.
- Subsidized vanpool programs organized by employers.
- Internal transportation services for trips beyond walking distance during the day.
- Teleporting for those whose jobs can be accomplished in this fashion.
- Restaurant-transportation-ticket packages for major athletic and entertainment events.
- Remote parking/shuttle transit service to both entertainment events and major employment sites.

Development/Land Use

- Provide more housing within the study area aimed at being attractive to study area employees; locate it where it can conveniently be served by transit.
- Locate more complementary land uses within close proximity of each other.
- Promote and provide incentives for mixed use developments containing complementary uses internally and within walking distance.
- Evolve commercial development to be more locally serving of area residents, businesses, and institutions rather than more region serving uses.
- Strongly promote transit and pedestrian oriented development.
- Provide shuttle services between complementary land uses during peak activity periods.
- Provide on-site convenience services to meet employees' mid-day needs.

Components of Alternative Strategies

The strategies considered in this study include a combination of:

- transportation operations improvements to increase the effectiveness of the existing system;
- policy changes that will enable the transportation system to provide more utility and/or reduce the demand on the system. These include policies that could affect future development patterns, business operations, and methods of providing transportation;
- institutional changes that could create additional methods to achieve mobility improvements and desired development patterns; and
- transportation infrastructure improvements to increase capacity and connectivity.

The magnitude of activity in the study area necessitates that the strategies be multi-modal to be effective and to use available resources efficiently. Principal travel modes considered essential to the future success of the area include:

- personal and commercial vehicles,
- public transportation,
- walking; and
- bicycling.

Since the area is almost virtually developed (i.e., very little vacant land), opportunities for new transportation rights-of-way are limited. Many of those opportunities will be associated with or become more viable as parts of redevelopments of land parcels or rehabilitation or reconstruction of transportation facilities. Hence, the approach taken in developing strategies has been to build the supply-side strategies around the road system and to use policies and programs to reduce vehicular travel where and to the extent feasible.

Three road system strategies were developed taking three different approaches:

1. Network improvement – improve existing transportation facilities to the extent needed. Employ new facilities only when improvements to existing facilities would provide insufficient capacity or continuity to meet needs. Include operational and policy changes as appropriate.
2. Connectivity – focus improvements on completing and filling in the street system to provide a more complete street *network* so available streets do not each have to carry as much traffic. Limit widening to as little as possible. Include operational and policy changes as appropriate.
3. Operational improvements – improve intersections and other operational elements instead of widening or adding new roads. Use latter approaches only if operational improvements will be insufficient to meet needs. Include policy changes as appropriate.

Each strategy emphasized the theme approach, although other types of improvements were used to achieve the needed additional capacity increases in north-south and east-west directions.

Components Common To All Strategies

Several improvements were common to all three concepts. This resulted either due to necessity or to lack of other available options. For example, the policy options inherent in all three concepts are the same (e.g., reduce travel demand). The following are improvements suggested for inclusion in all three strategies:

- Road system
  - Maintain and regularly re-time traffic signal system to serve current traffic demands and patterns.
  - Provide high water access routes to TMC health care and critical support facilities.
  - Facilitate and prioritize transit operations where possible.
  - As part of any improvement to increase north-south access and capacity near MacGregor Way and North and South MacGregor, relocate North and South MacGregor to an alignment adjacent to Brays Bayou from approximately Almeda to MacGregor Way.
  - Complete the planned Bertner extension from Pressler to Knight south of its fanning intersection, configuring the Knight-Bertner intersection to facilitate north-south movement to provide a north extension of existing Knight to provide additional freeway access to the TMC and planned bio-technology park.
  - Complete West Bellfort between Stella Link and Buffalo Speedway.

- Traffic operations

- Develop detailed transportation management plans (multimodal) for major institutions and major event facilities to include normal peak period, special event and emergency conditions.
- Create and apply an access management policy to preserve the available capacity of existing roads and enhance safety.
- Convert Golf Course Drive to full-time one-way southbound operation to reduce traffic congestion near the zoo and approaching MacGregor Way and to provide more curbside parking along Golf Course Drive.
- Promote the use of Braeswood west of Greenbrier and connect it to Old Spanish Trail via Stadium Drive.
- Connect future HOV lanes in SH 288 or IH-610 to major the thoroughfare system of study area.

- US 59
  - Install freeway signing to encourage US 59 traffic to use the Main/Fannin ramps or SH 288 to reach major destinations rather than Shepherd/Greenbriar.
  - Construct the planned north/eastbound exit ramp to Main Street to improve the intersection with main Street to efficiently accommodate the resulting traffic movements.

- IH-610 and SH 288 access to study area
  - Improve SH 288 – Southmore-Binz-MacGregor ramping as part of SH 288 Brays Bayou bridge replacement to reduce queues onto the freeway and weaving deficiencies at MacGregor ramps and frontage roads.
  - Improve SH 288 – Yellowstone-Old Spanish Trail-Holcombe ramps and intersections to increase capacity.
  - Improve SH 288 – Holly Hall interchange to provide access to/from the south.
  - Raise IH-610 to enable Knight and Cambridge to connect to both frontage roads and extend streets as continuous streets to the south.
  - Add IH-610 access to/from both east and west serving Almeda-Cambridge-Knight. Make Knight and Cambridge continuous across the freeway enabling existing streets east of Kirby to assist in providing full access to/from the area via IH-610.
  - Extend frontage roads through the IH-610/SH 288 interchange.
  - Improve IH-610 – Main to provide more capacity to/from west (direct connector ramp).
  - Extend frontage roads through IH-610/SH 288 interchange.

- Emergency access during floods
  - Designate SH 288 (frontage roads) and Main Street north of TMC as primary access routes during floods, subject to results of flood water monitoring by county and TranStar. In reconstructing MacGregor between Almeda and MacGregor way, raise roadway elevation out of flood plain and construct drainage ways under the roadway for water flowing toward the bayou.
  - If Cambridge is selected as additional north-south route across Brays Bayou, raise the elevation of Cambridge out of flood plain and provide drainage to accommodate water draining out of the Devonshire subdivisions. Realign Cambridge to the east to properly accommodate such improvements. If another alignment is selected, construct Cambridge high enough to be above flood plain and accommodate area drainage needs.

- Transit service
  - Provide direct service between major trip origins and destinations within and to/from major study area destinations.
  - Regularly monitor both demand and service and modify service as new developments are completed and travel patterns change.

- Pedestrian travel
  - Implement the TMC master plan grade-separated sky bridge system joining areas north and south of Holcombe and connecting to LRT stations and bus stops.
  - Create a more pedestrian friendly environment:

    - sidewalks on all streets;
    - direct walkways between major destinations;
    - convenient, direct access to transit stops;
    - building entrances near streets and sidewalks;
    - safe pedestrian crossings;
    - grade separations at major crossings, especially between multi-story buildings; and
    - attractive pedestrian walkways with as few vehicle conflicts as possible.

- Bicycle travel
  - Provide grade separated commuter bike routes along Brays Bayou.
  - Where possible, provide direct commuting routes along the periphery or through Herman Park and along boulevards with lower traffic volumes and along utility corridors within and leading to the study area.

- Parking
  - Locate parking along or adjacent to major thoroughfares providing access to the area.
  - Locate parking on peripheries of major developments rather than internally, but not obstructing direct and convenient pedestrian access to buildings.
  - Where parking cannot be provided on-site, remote parking should be located along major access routes and be directly served by shuttles. Remote parking facilities should be sufficiently large to permit frequent shuttle service to be feasible.
  - Locate, design and manage valet parking so it does not congest access, self-parking, or adjacent sidewalks and streets.

- Land development
  - Provide more housing within the study area aimed at being attractive to study area employees to improve localized job-work force balance and reduce long distance commuting. Locate new housing where it can conveniently be served by transit.
  - Locate more complementary land uses within close proximity of each other.
  - Promote and provide incentives for mixed use developments containing complementary uses internally and within walking distance.
  - Evolve commercial development to be more locally serving of area residents, businesses, and institutions rather than more region serving uses.
  - Strongly promote transit and pedestrian oriented development.

- Provide shuttle services between complementary land uses during peak activity periods.
- Encourage site plans that promote walking rather than use of motor vehicles (e.g., parking behind buildings, small setbacks from street, etc.).
- Ensure existing transportation access routes to critical facilities as well as important support facilities (e.g., emergency access, loading docks, physician parking) are above 100-year flood plain level.

- Other Policies
  - Take measures to reduce total and peak period vehicular travel demand (incentive, benefit based).

Strategy 1 – Network Improvement

Figure 5 shows the roadway system changes suggested to be part of the network improvement strategy. These include:

- Modify street design on Shepherd-Greenbriar between US 59 and Rice Boulevard to reduce traffic speeds to about 25 mph;
- Improve intersections at approximately 19 locations by adding turn lanes or other geometric improvements, modifying traffic signal operations, and increasing safety. Also improve intersections of thoroughfares with freeway frontage roads for similar purposes;
- Widen Holcombe to eight lanes plus turn lanes between approximately Brays Bayou and Shamrock to increase east-west capacity and reduce congestion;
- Intersection grade separation at Holcombe-Braeswood;
- Connect MacGregor Way and Cambridge with a new Brays Bayou crossing and provide a four-lane thoroughfare between MacGregor and IH-610 (Appendix A shows the basic options to be evaluated, including configurations both east and west of Devonshire subdivision to be examined) to provide additional IH-610 access to the north side of TMC, Rice University, and Hermann Park. Several additional variations of these options may be examined;
- Improve geometrics to make "direct" connection between Old Spanish Trail and Braeswood via Stadium Drive to gain more east-west connectivity across the study area; and
- Complete the gap in West Bellfort between Buffalo Speedway and Stella Link to provide a continuous east-west street south of Holcombe.

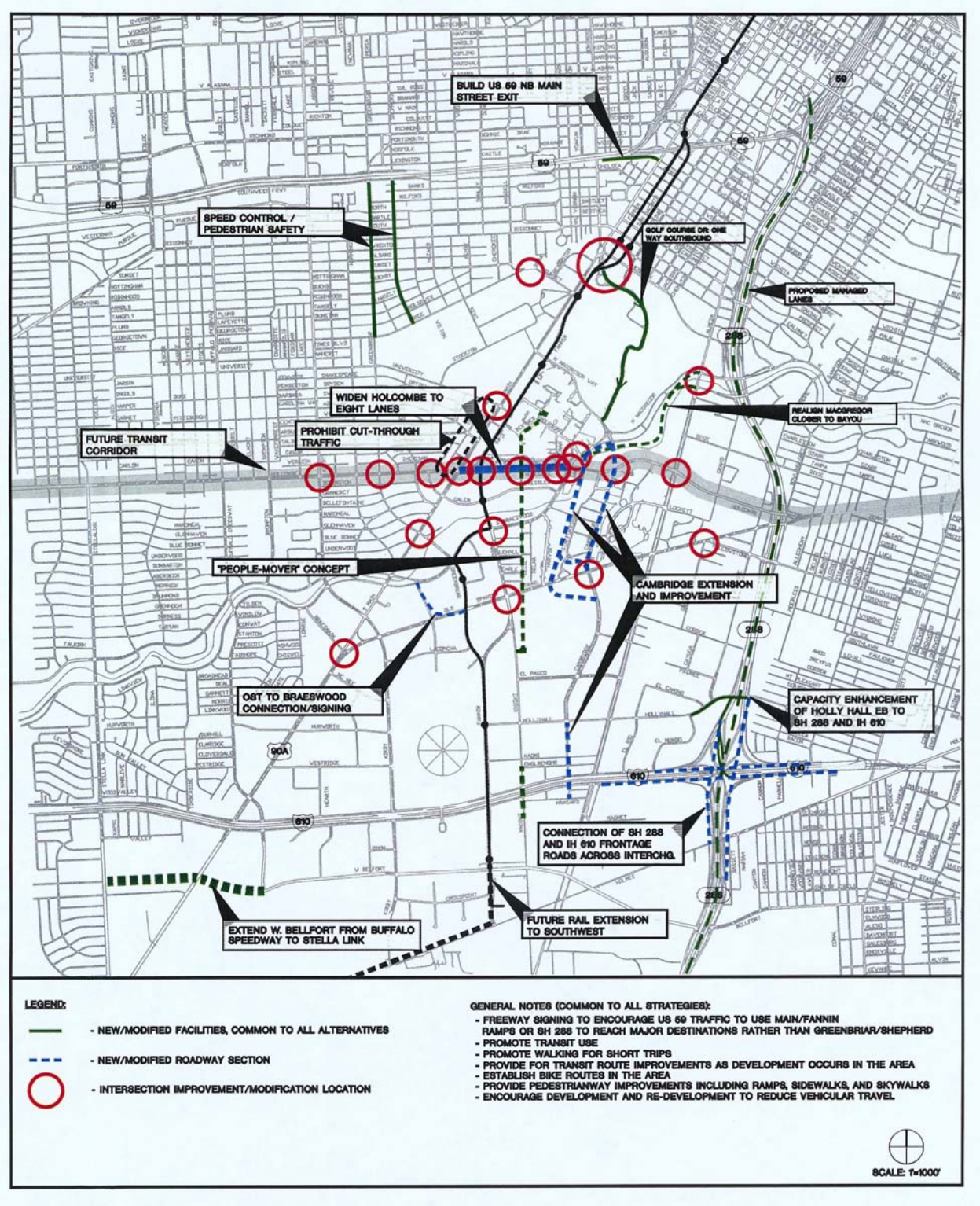


FIGURE 5: Strategy 1: Network Improvements

Strategy 2 – Connectivity

Figure 6 shows the roadway system changes suggested to be part of the connectivity improvement strategy. These include:

- Extend Dixie west across Brays Bayou to North MacGregor and widen Dixie to four lanes to SH 288 and provide freeway access either by extending frontage roads to serve Dixie or provide ramps to SH 288. Configure Dixie-Almeda intersection to promote use of Almeda as alternative access to IH-610;
- Improve Holcombe intersections between Kirby and SH 288 to increase capacity and reduce congestion;
- Widen Greenbriar from two lanes to four between University and Main Street to provide continuity of north-south capacity on Greenbriar;
- Improve geometrics to make "direct" connection between Old Spanish Trail and Braeswood via Stadium Drive to gain more east-west connectivity across the study area;
- Construct the following sections of street to further complete the area street system (most would be collector streets):

    - Grand between Lockett and Old Spanish Trail and between Corder and El Camino,
    - El Camino between Grand and Almeda,
    - La Concha between Cambridge and Fannin and between Kirby and McNee,
    - Latern Point Drive between Westridge and IH-610, and
    - Travis between Old Main and Holcombe;

- Modify the area in the vicinity of Holcombe and Braeswood to eliminate the crossing of east-west streets Holcombe and Braeswood by linking Holcombe-MacGregor and Holcombe-Braeswood, but provide a link between the two new east-west streets;
- Connect Ardmore south of Brays bayou to Ennis north of Braes Bayou to eliminate the circuitous travel necessary to go from north to south across the bayou at that point; and
- Provide direct outbound ramps from Reliant Park to IH-610 to reduce event congestion on Main, Fannin, Kirby.

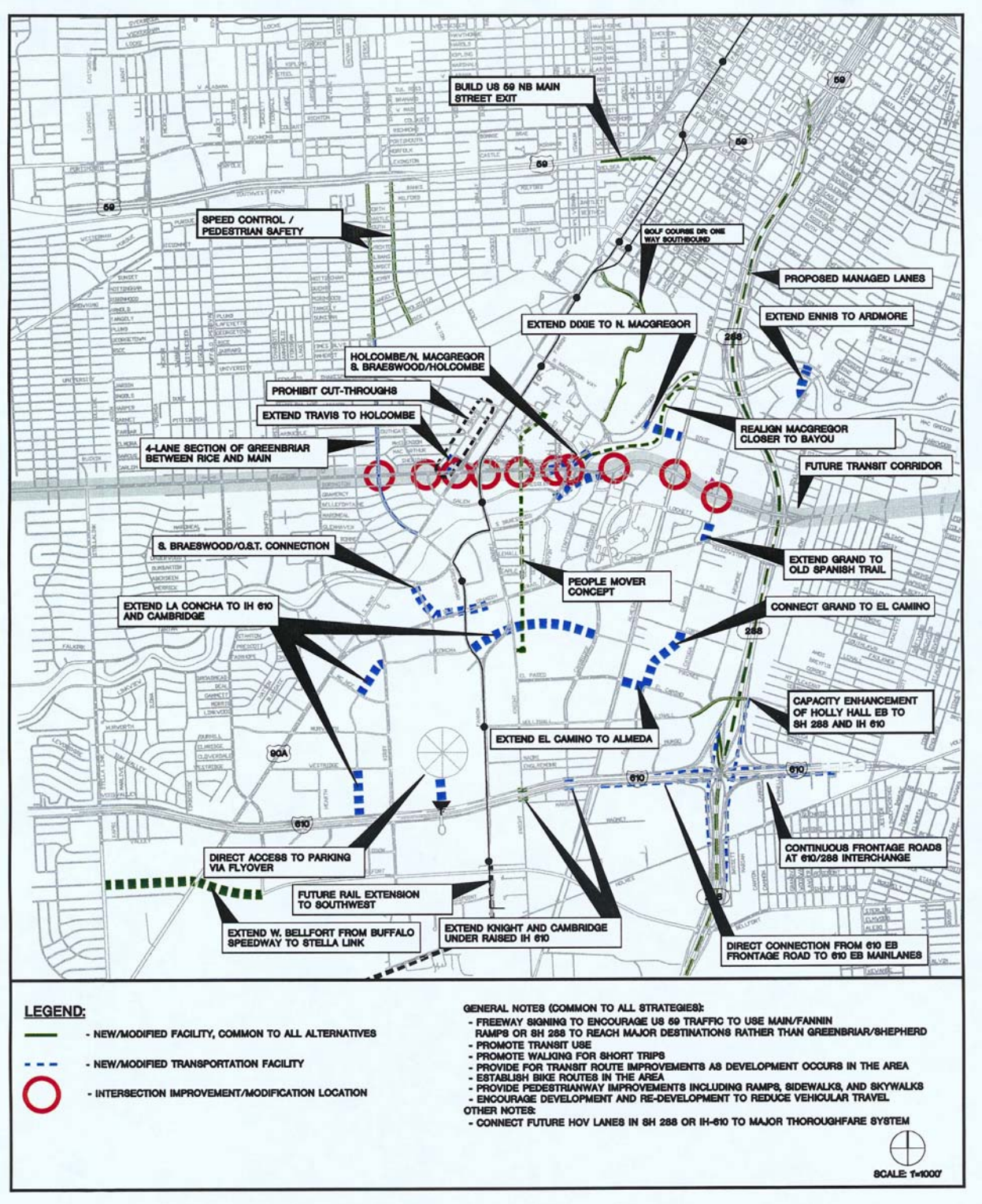


FIGURE 6: Strategy 2: Connectivity Improvements

Strategy 3 – Operational Improvements

Figure 7 shows the roadway system changes suggested to be part of the operational improvement strategy. These include:

- Improve approximately 44 street intersections shown on Figure 7 to add turn lanes, improve traffic signal operations and traffic safety, and expedite transit movement. Also improve intersections of thoroughfares with freeway frontage roads for similar purposes.
- Convert Holcombe and Shamrock-Galen/Pressler to a one-way pair between Shamrock and Braeswood. Each street would have four traffic lanes plus turn lanes where needed. To keep transit close to the center of the TMC core, eastbound bus lanes would be provided on the south side of Holcombe separated from the westbound traffic lanes by a median similar to the existing median.
- Provide HOV lanes on SH 288 and IH-610 with access to major thoroughfares serving TMC and other major destinations. This could alternatively include toll express or other applications of managed lanes on SH 288.
- Modify Holly Hall, Murworth, and McNee to employ reversible lanes during peak event inbound and outbound peak periods. Make Dixie reversible between MacGregor and SH 288 to increase capacity of SH 288 access to TMC.
- Improve SH 288 – Holly Hall interchange to accommodate reversible operation on Holly Hall and to provide access to/from the south.
- Within individual developments, provide more on-site convenience services to serve mid-day needs of employees and patrons (to reduce need for personal vehicles).
- Adopt more aggressive travel demand management policies and programs than under other strategies.

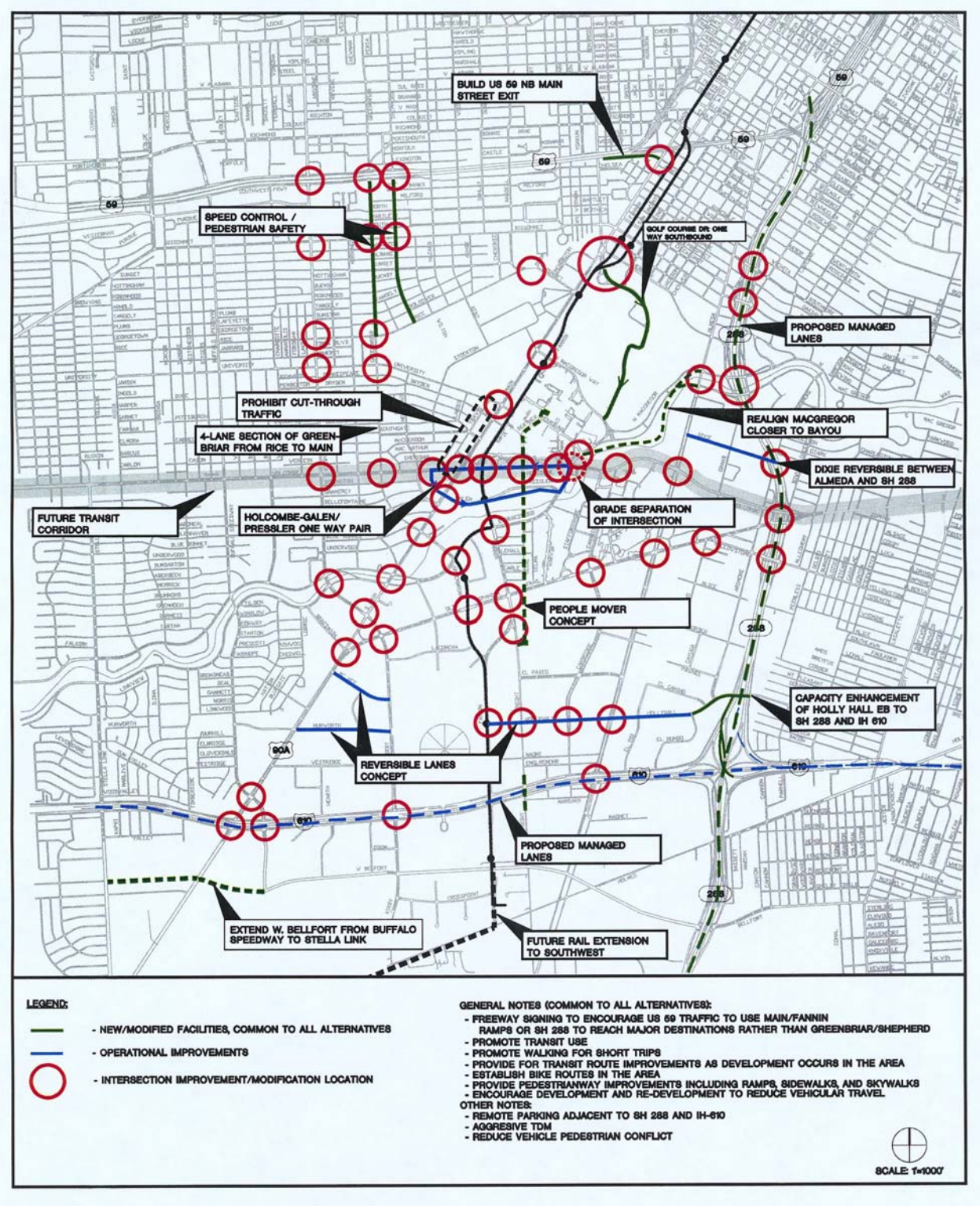


FIGURE 7: Strategy 3: Operational Improvements

Steps To Develop Long Range Strategy And Short Term Projects

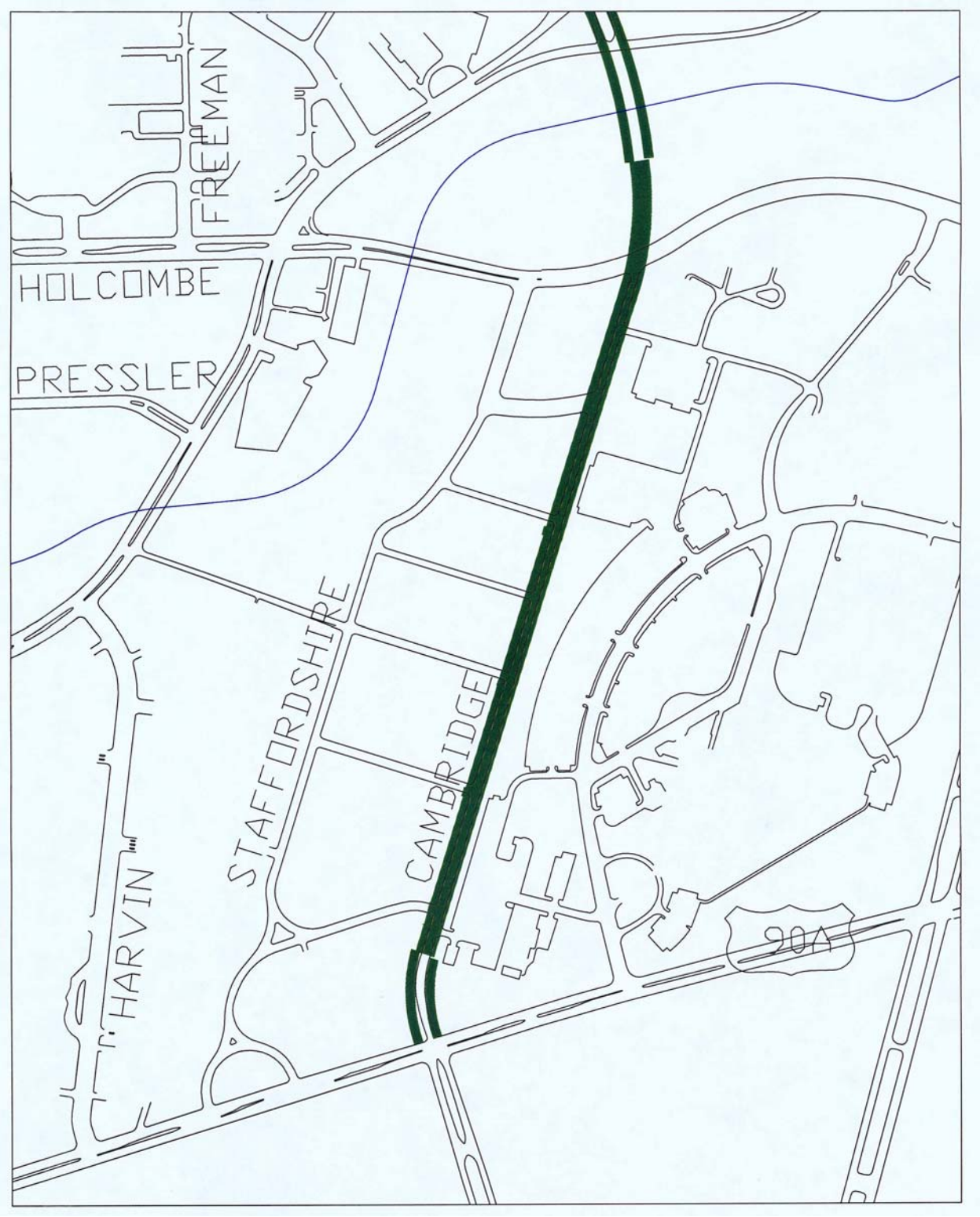
The long-range strategy, to cover the period until 2025 and perhaps beyond, will be developed from a combination of a technical evaluation of the alternative strategies in conjunction with input from the study's Steering Committee and Technical Committee. The two committees and study team will also consider input from the public as received at the public meetings held to discuss the study. It is anticipated that the final long-term strategy will consist of some combination of improvements suggested for consideration under the three strategies.

The long-range strategy will provide a "map" to base a short-term list of improvements to be pursued in more detail as part of Phase 2 of this master planning effort and/or though other planning and engineering efforts. It is expected that the current Phase 1 master plan work will result in an overall strategy and preliminary plan with some details to be examined further during Phase 2. Such details might include specific location and alignment studies, operational analyses, environmental reviews (not NEPA environmental impact statements or assessments), or other examinations intended to take potential improvements to the point where the implementing agencies can make plan adoption, institutionalizing, and, for short-term projects, funding decisions.

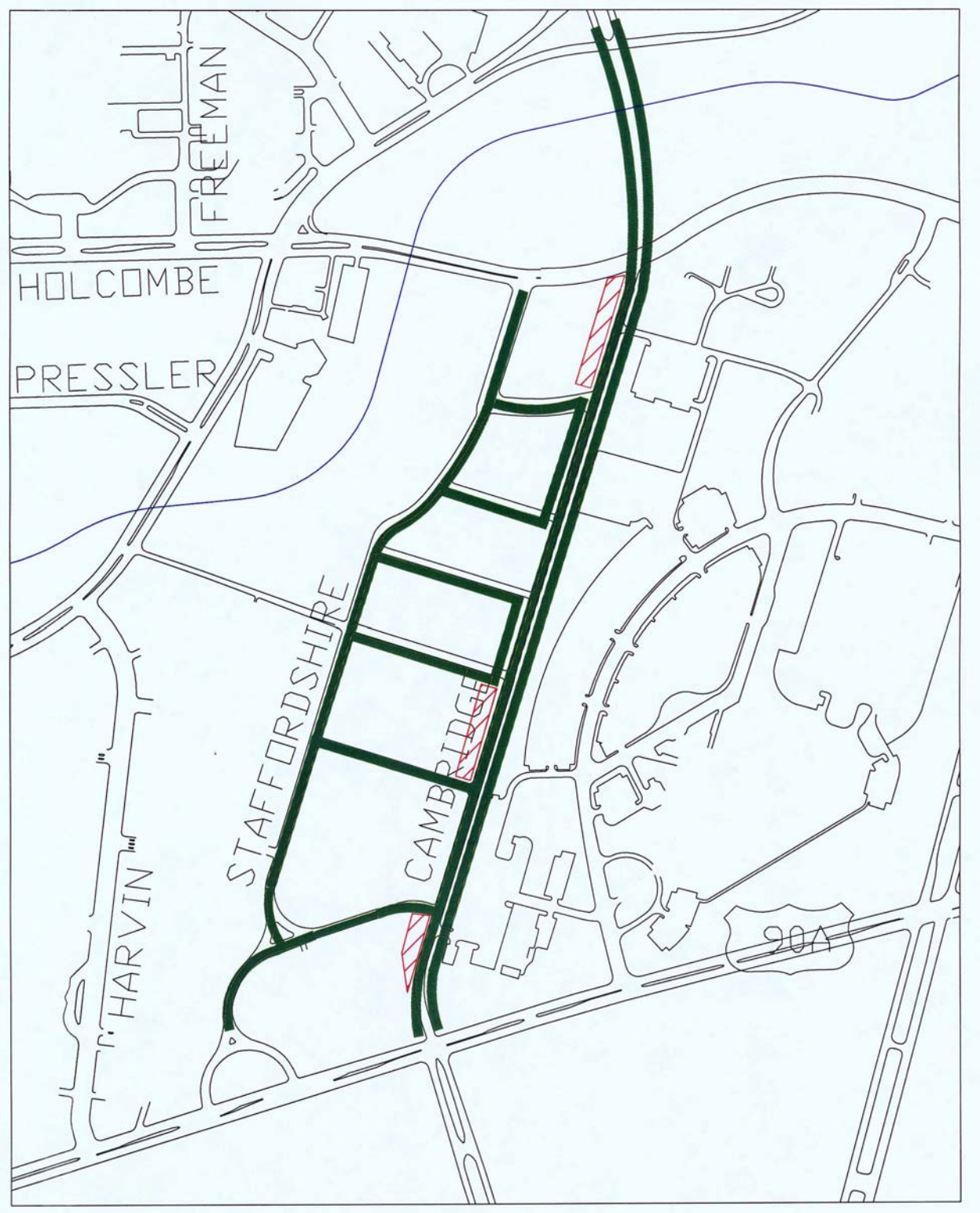
Short-term projects will be selected from among the long range improvements based on criteria to be established during the strategy evaluation process. The project selection criteria will be related to the long-term strategy evaluation criteria, but will include other considerations related to implementation steps. These will be selected once the evaluation of the long-range strategies is completed.

It is anticipated that the short-term projects will include policies, operational improvements, and infrastructure improvements. It is also expected that each implementing agency – the City of Houston, Harris County, METRO, and Texas Department of Transportation – will have projects recommended for the short term.

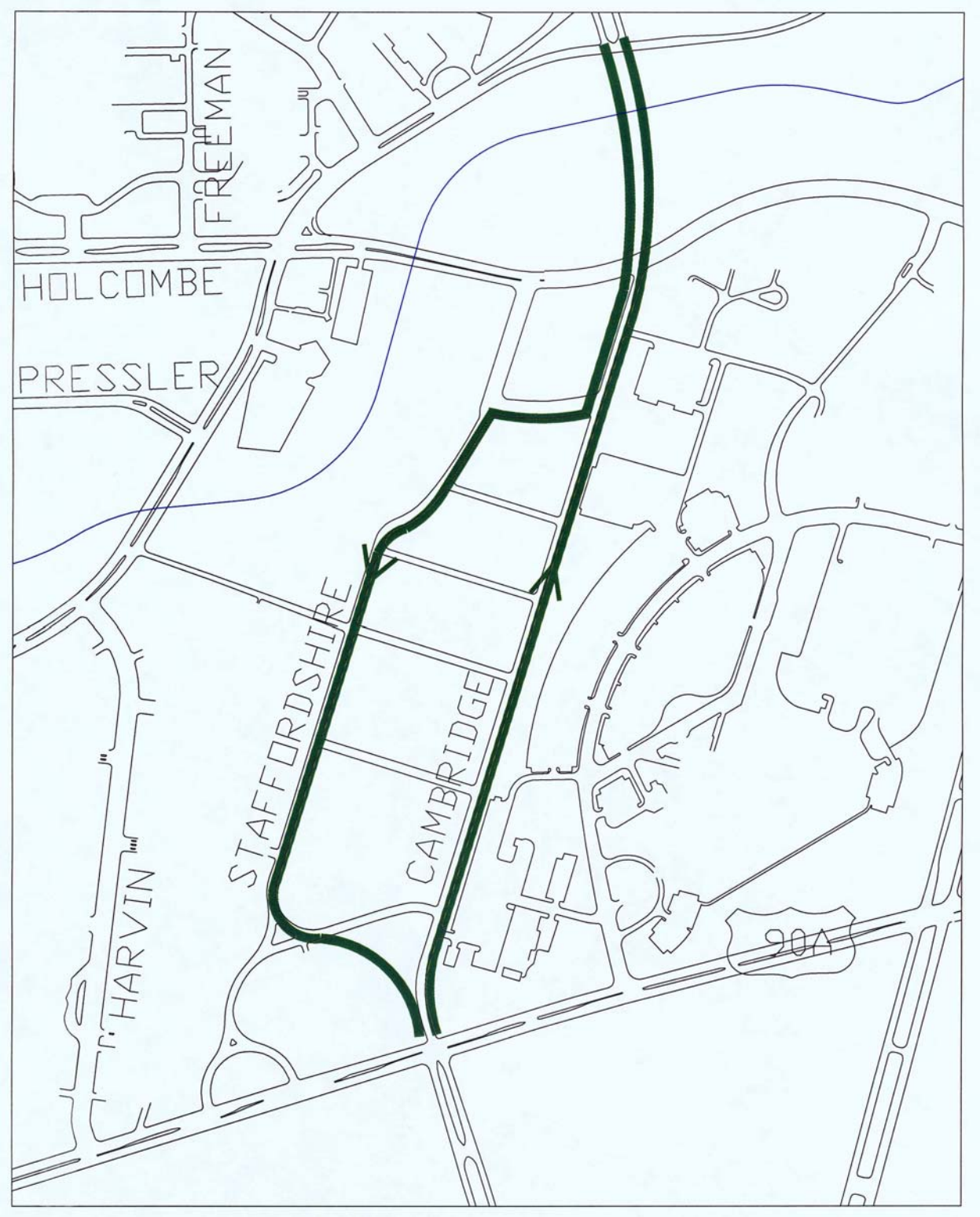
APPENDIX
Possible Alternative Bayou Crossings (not shown: Dixie-Almeda option)



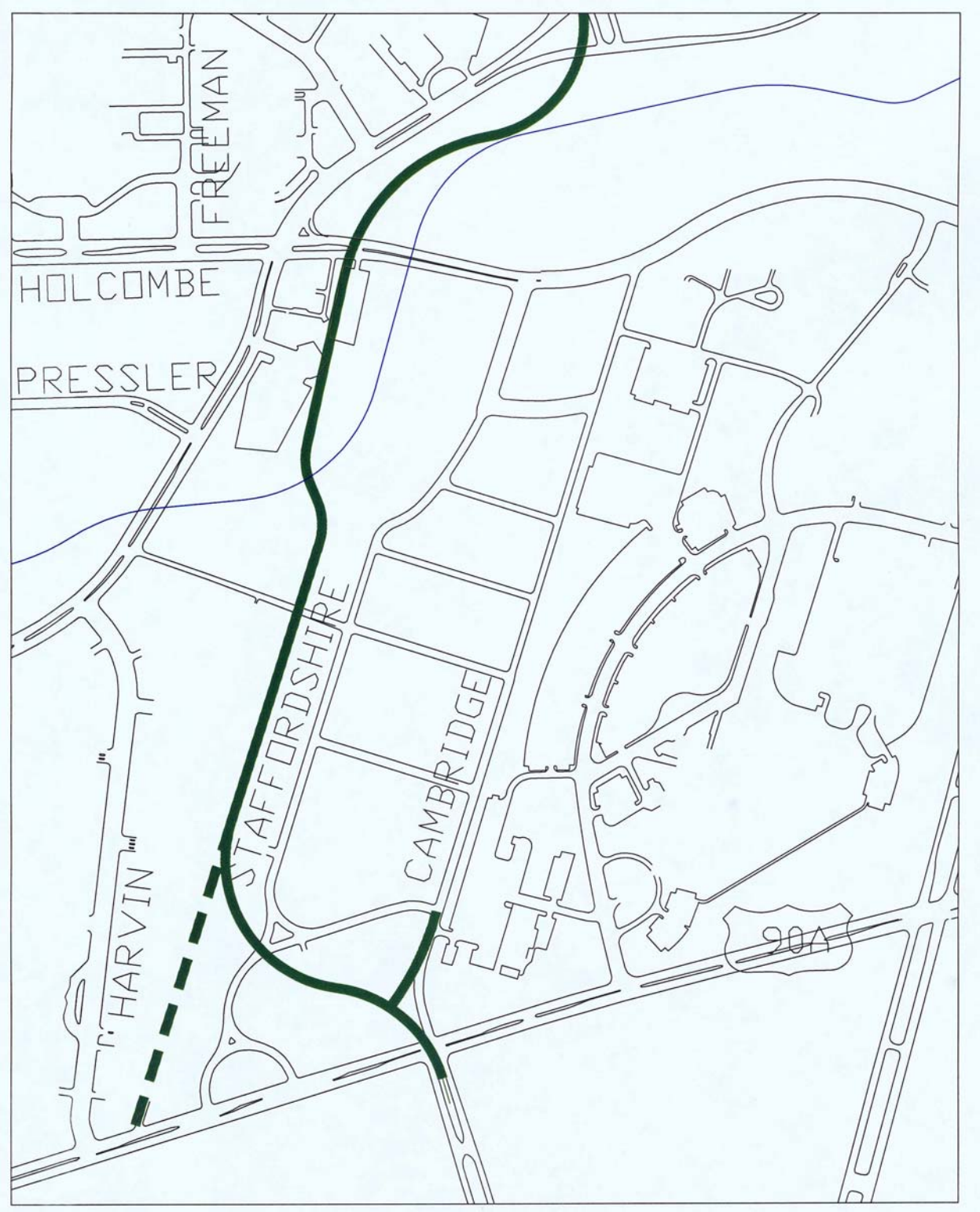
Option 1: Existing Cambridge Alignment



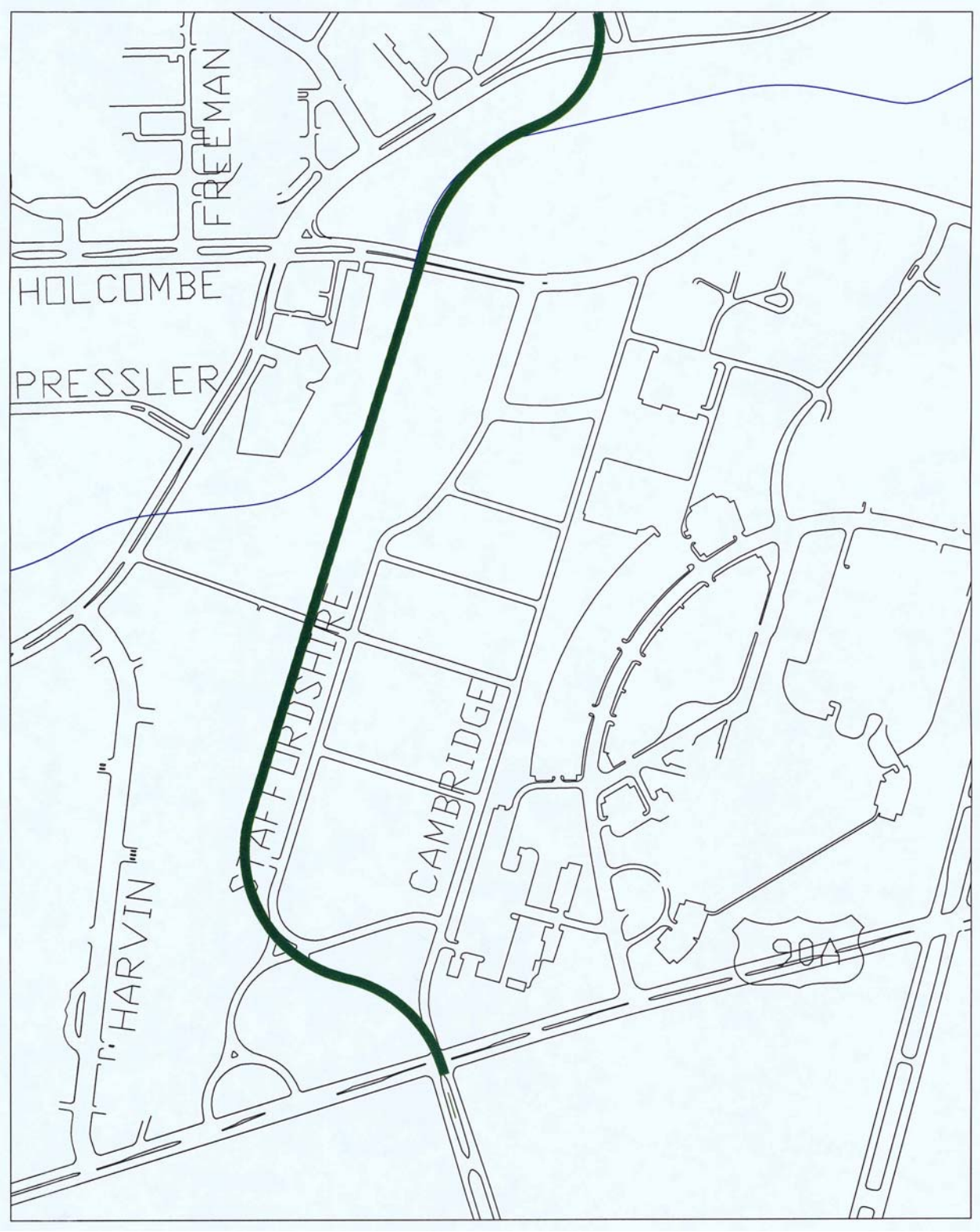
Option 2: Existing Cambridge Converted into a Boulevard With Limited Access



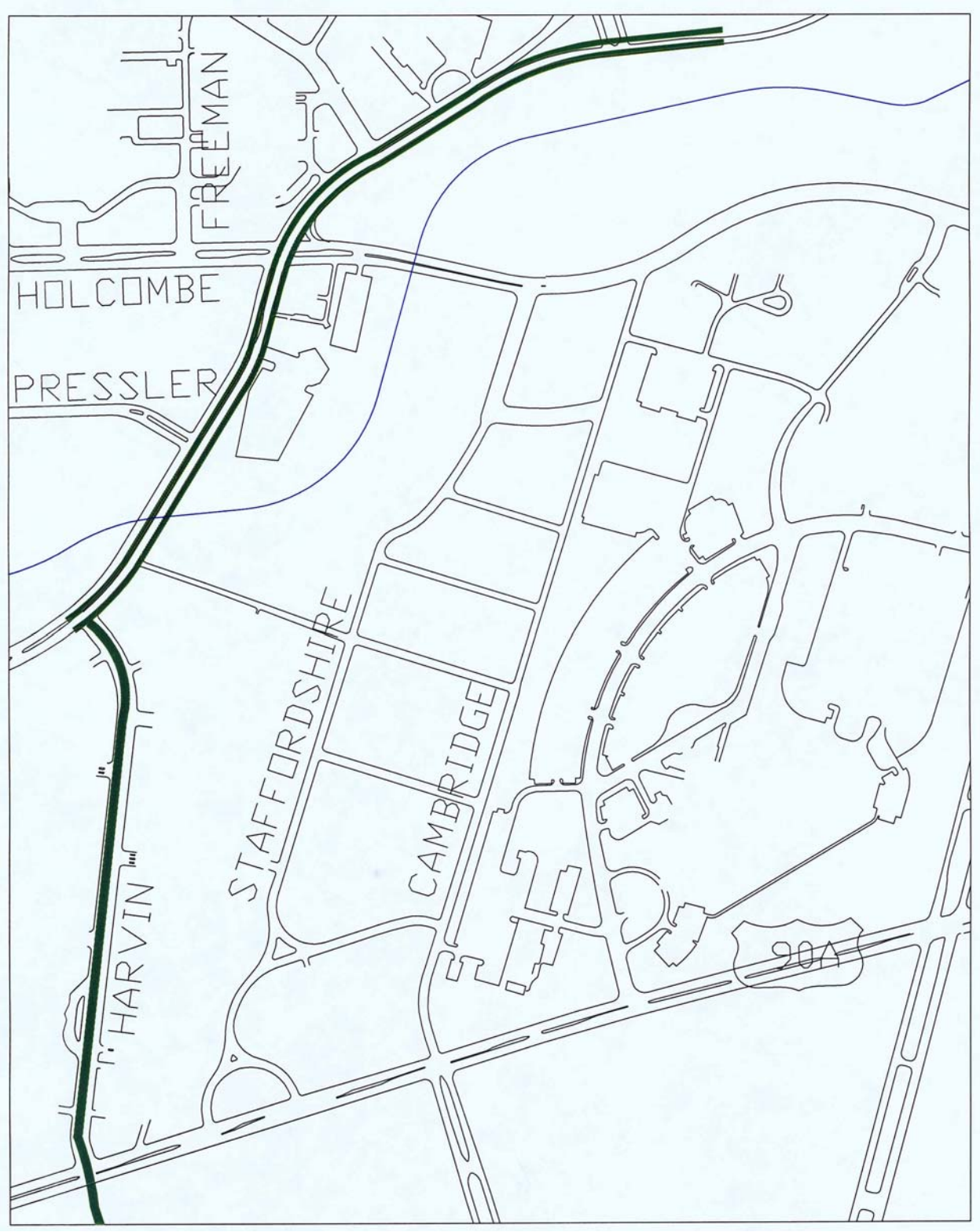
Option 3: Staffordshire/Cambridge One-way Pair



Option 4: New Western Alignment Between Braeswood and the Bayou



Option 5: New Western Alignment Along Bayou



Option 6: New Western Alignment Along Braeswood and Harvin

Option 7: New Western Alignment with Grade Separation at Holcombe

Option 8: One-way Pair Between Braeswood and New Western Alignment